

BELLONA

SERIES 21

MILITARY VEHICLE PRINTS



SERIES TWENTY ONE

7.5 cm PAK 40/2 auf Sfl II "Marder"	(GE)
Heavy Assault Tank A 39 "TORTOISE"	(UK)
Light Tank Mark IA. A4. E6, E7, E8, E9, and E10	(UK)
75 mm Howitzer Motor Carriage T 3	(US)

DETAILED PLAN VIEWS PRESENTED IN 1:76 & 1:48 SCALE



ABOVE: One of the early versions of the 'Marder II' described in detail on Page 3 and shown in the four view drawing. The chassis of this vehicle is from the Ausf. A, B or C versions of the Panzerkampfwagen II. While the nose of the chassis appears identical to the Ausf. F it is in fact formed by the welding of additional flat armour plates over the original rounded nose plate of these early models.

COVER ILLUSTRATION - DRAWN BY GEORGE BRADFORD.

Page 2.

The vehicle drawn is one of the late units described in the text on page 3. The markings are those of a Panzerjäger unit, as they appeared on the 'Marder II' during field trials and training prior to their employment on the Russian front. These self-propelled guns were similar to most German vehicles of the period as far as colour was concerned.

BELOW: This 'Marder II' does not appear to fit into the regular series production vehicles. It must be assumed that it is either a prototype or a vehicle specially constructed for training purposes. Note: the lack of splash protection around the gun shield, unusually high armour in front of the gun race, the dummy visor normally only seen on the regular Panzerkampfwagen II Ausf. F, the wide based travel lock, and rack for track links.



Historical research by Walter J. Spielberger. Drawing and technical research by H.L. Dayle.

(It is suggested that this vehicle be studied with a close reference to Bellona Prints Series 17, No.68 GE - Pz Kpfw II Ausf. F. and Series 5 No.20 GE - 10.5cm Pz FH 18 auf GW II 'Wespe')

Events in Russia shortly after the German invasion in 1941, had increased the demand for more powerful anti-tank weapons to such an extent that many make-shift solutions had to be improvised. With the advent of the Russian T34 tank most of the standard German anti-tank guns were rendered obsolete overnight. At first a large number of captured guns were pressed into service. The majority of these were multi-purpose Russian 7.62cm FK 296(r). The new German 7.5cm Pak 40 then under development was of similar size and weight and it soon became apparent that with these heavy weapons mobility was decreased. This became a prime concern of the German Ordnance department. Suitable tractors were available only in limited numbers, and since these were semi-tracked vehicles they were usually issued to motorized units. The Infantry had to be supplied with weapons suitable for drawing by horse teams, but it was the Infantry who suffered most during the numerous Russian tank attacks and for its survival a quick solution to combining firepower and mobility had to be found.

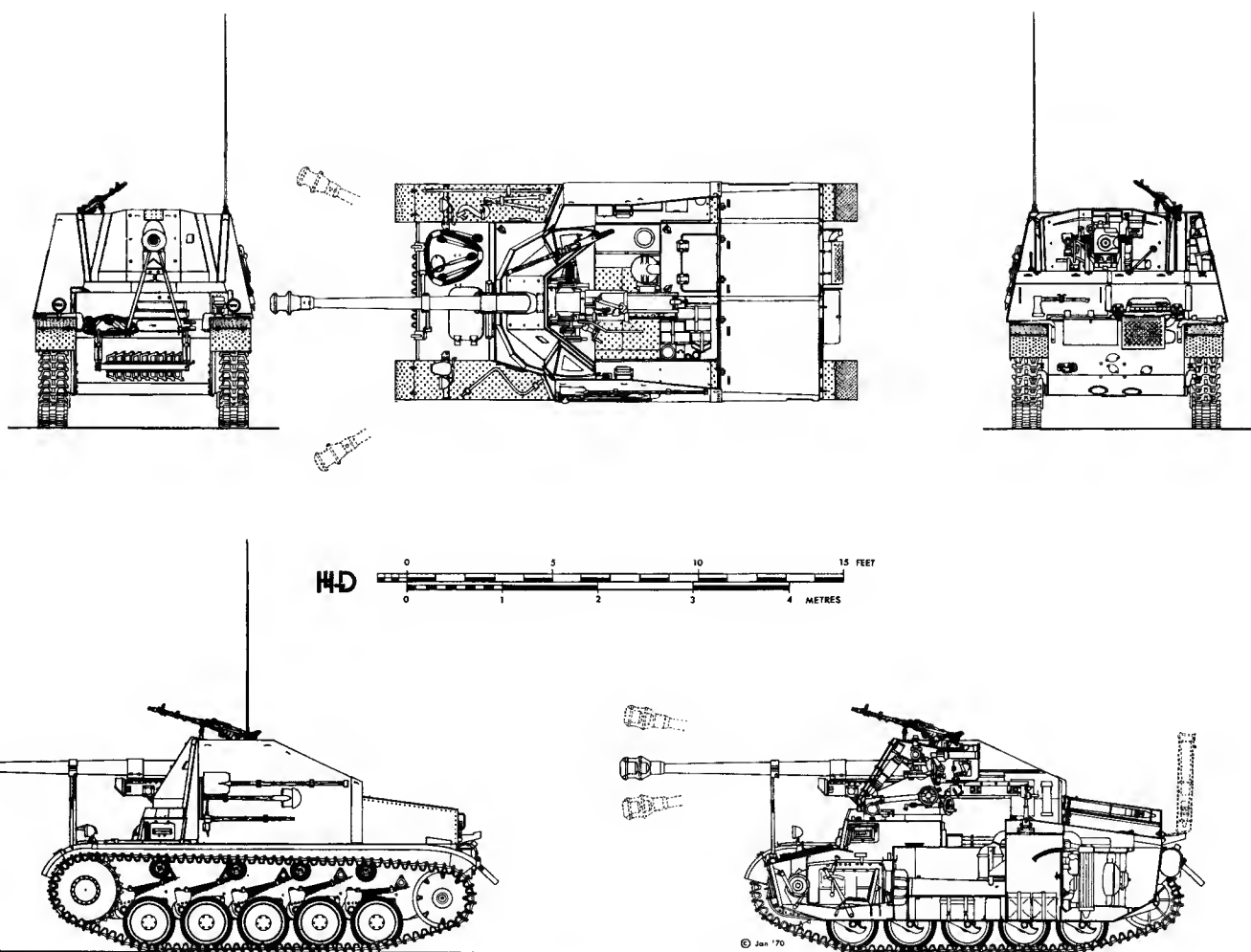
The inadequacy of the light tanks, PzKpfw I, II and 38(t), brought about a shift in German tank production from these types to the PzKpfw III and IV, and made available not just supplies of outdated fighting vehicles, but also their production facilities.

An initial order to convert PzKpfw II vehicles into self-propelled tank destroyer vehicles was issued by the Ordnance department as early as December 1941. This anticipated the use of the Ausf. D and E, a version of which only a limited number had been produced. By 12th May 1942, 150 of these units had been converted to carry the rechambered Russian 7.62cm. These were issued as the 7.6cm Pak 36(r) auf Fgst. Pz Kpfw II (Sf). Continuous supply was then dependant on the availability of additional chassis. Meanwhile a similar requirement caused the production of the Panzerjaeger 38 (t) fuer 7.62cm Pak 36(r) in Prague. (Bellona Prints, Series 10, No.38 GE)

By then the regular German 7.5cm gun was available and pressing need forced Waffenamt to follow up with a supplementary order dated 18th May 1942, for the withdrawal and utilisation of the standard 'Las 100' chassis of the Pz Kpfw II. Responsibility for chassis modification was entrusted to the Maschinenfabrik Augsburg-Nuernberg AG., the original parent company which had developed this type. Alkett at Spandau developed the armoured superstructure while the 7.5cm gun was the responsibility of Rheinmetall-Borsig. During initial trials the already obsolete 5cm Pak 38 had to be used for this modification. Chassiswise, all available Pz Kpfw II chassis ranging in serial numbers from 20000 to 27000 were scheduled to be used. In practice they were of the Ausf. A, B and C series from number 21101. Subsequently, however, the Ausf. F chassis were also utilised.

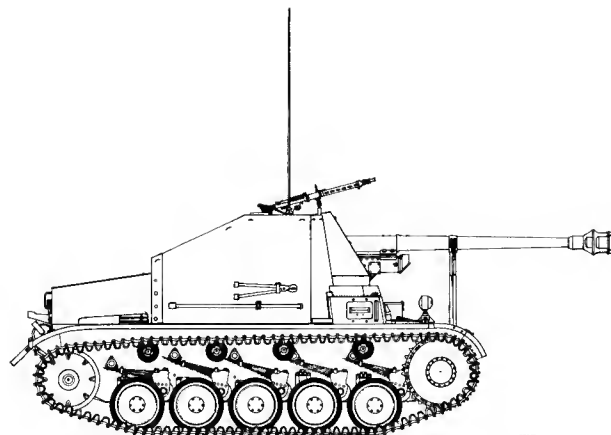
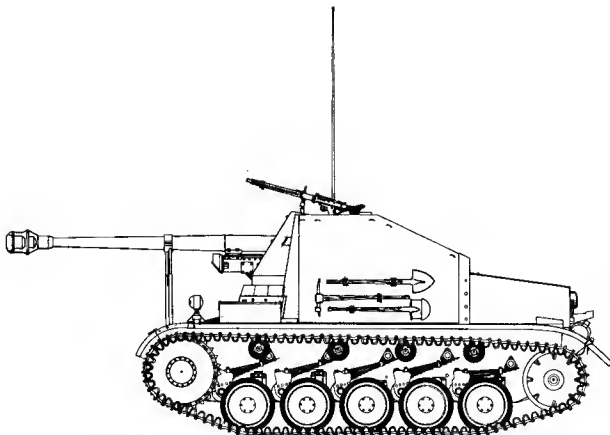
The gun was a slight modification of the standard 7.5cm Pak 40. After removing it from its field carriage, the entire unmodified upper part was mounted on the roof of the tank hull, as can be seen in our section view drawing. Limited traverse was provided which amounted to 32 degrees to left and 25 degrees to the right. To protect the gun race from damage during road movement travel locks were provided for the gun which were removed prior to battle. Both gunner and loader were protected in front and on the sides by a rigid armoured superstructure. The armour was proof against small arms and shell fragments only. The ammunition supply for the main armament was carried in a series of armoured bins mounted over the existing engine covers. The main left section held 24 rounds and the right section a further 6 all in deep rows. The centre portion over the engine access hatches carried a single row of 7 rounds. As can be seen in the section drawing this compartment could be hinged upward to allow attention to the engine. An intercom for the three crew men was available and also a radio set 'd'. For protection against inclement weather, a canvas tarpaulin was provided to cover the fighting compartment. In battle the gunner acted as commander while the driver also operated the radio equipment.

Production and assembly of these vehicles commenced at the Fahrzeug-und Motorenwerke GmbH. of Breslau, a company which also had established a subsidiary in Warsaw, Poland. The first vehicle left the assembly lines on 15th June 1942. In February 1943 Hitler ordered that the Pz Kpfw II chassis be used solely for the 'Wespe' carriage while the Pz Kpfw 38(t) be used only for the 7.5cm Pak 40. Thus the two factories only produced 327 units in 1942 and a further 204 in 1943. The official nomenclature of the vehicle was 7.5cm Pak 40/2 auf Sfl. II (Sd Kfz 131) 'Marder II' Photographic evidence shows that experiments were carried out with these vehicles equipped with an infra red projector and telescopes for



7,5 cm. Pak 40/2 auf Selbstfahrlafette II

SCALE 1:76 (4 mm to 1 foot) DRAWN BY H.L.DOYLE.



Technical Specification for 7.5 cm PAK 40/2 auf Sfl. II 'Marder II'

Crew: 3

Weight, Combat loaded: 23810 lbs.

10.63 Long tons, 11.90 short tons.

10.8 Tonnes.

Performance

Speed, Max. Road: 24.85 m.p.h. (40 Km.p.h.)

Cross country: 12.43 m.p.h. (20 Km.p.h.)

Max. Gradient: 30 degrees.

Fording depth: 3' 0½" (92 cm)

Trench crossing: 5' 7" (170 cm)

Step: 1' 4½" (42 cm)

Min. Turning circle: 15.9" (4.8 metres)

Ground pressure: 10.8 lbs/sq.ins. (0.76 Kg/sq.cm)

Range (internal fuel), Road: Miles (190 Km)

Cross country: 77.7 Miles (125 Km)

Power to weight ratio: 12.7 Metric HP/ton.

Dimensions

Length overall: 20' 3" (618 cm)

Length: 15' 11" (486 cm)

Width overall: 7' 7" (231 cm)

Ground clearance: 1' 1½" (34 cm)

Height: 7' 5" (227 cm)

Fire height of gun: 6' 4½" (194 cm)

Trackwork

Centres: 6' 2" (188 cm)

Length on ground: 7' 10½" (240 cm)

Width: 11½" (30 cm)

Pitch: 3 5/8" (9.21 cm)

Number of links per track: 106/7

Mechanical Details

Engine: 1 x Maybach HL 62 TRM 6 cylinder inline, water cooled petrol engine of 6.191 litres developing 140 bhp at 2600 rpm.

Transmission: ZF SSG 46 gearbox with 6 forward and 1 reverse speeds.

Steering: Epicyclic clutch and brake.

Suspension: Five equally spaced road wheels with quarter elliptic lead springs. Later version with valute spring bump stops on first, second and fifth stations.

Armament

Main: 1 x 7.5 cm Panzerjaegerkanone 40.

Calibre, and length in calibres: 7.5 cm (2.95 ins) L/46

Traverse: 25 degrees right, 32 degrees left. Operation: hand.

Elevation: plus 10 degrees, minus 8 degrees.

Secondary armament: 1 x 7.92 mm MG 34.

1 x 9 mm MP 38

3 x Pi 08

1 x signal pistol.

Stowage

Ammunition: 7.5 cm PAK 40 - 37

Ammunition: 7.92 mm MG 34 600 rds.

9 mm MP 38 - 6 x 32 rds.

12 signal

20 grenades.

Internal Fuel capacity: 37.42 Imp. gals.

44.92 U.S. gals. 170 Litres.

Armour

Hull: As for Ausf F chassis (Bellona Print Series 17, No.68 GE) or Ausf A, B and C chassis.

Nose, Outer: 0.780" (20 mm) at 77 degrees.

Inner: 0.588" (15 mm) at rounded

Glacis plate: 0.588 + 0.588" (15 + 15 mm) at 13 degrees.

Drivers plate: 0.588 + 0.780" (15 + 20 mm) at 80 degrees.

Sides, 0.588" (15 mm) at 90 degrees.

Rear, 0.588" (15 mm) at 81 degrees.

Decking: 0.384" (10 mm) at 0 and 8 degrees.

Belly, 0.192" (5 mm) at 0 degrees.

Superstructure

Front: 0.384" (10 mm) at 81 degrees.

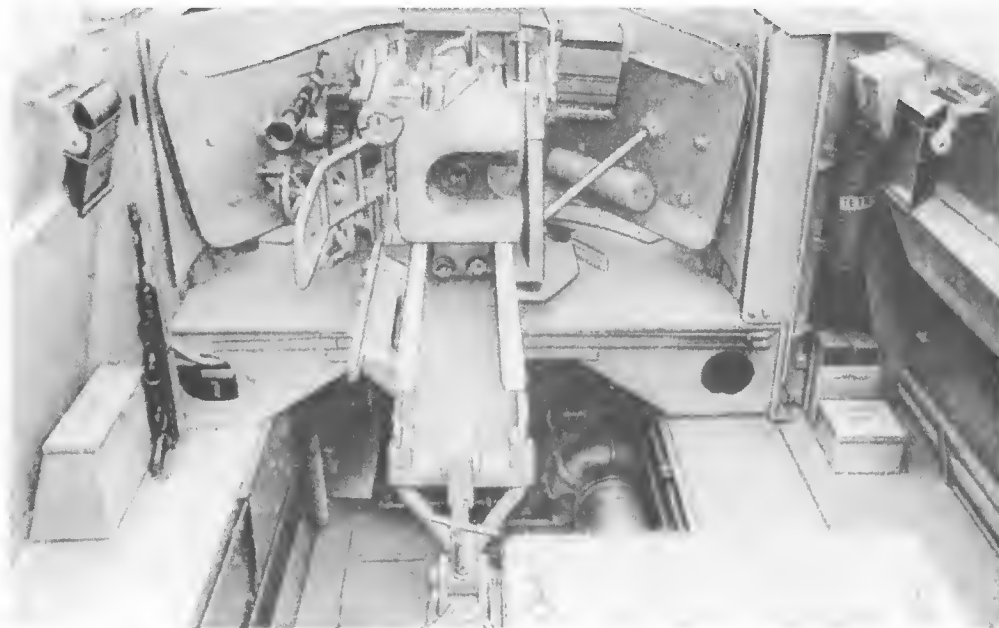
Sides: 0.384" (10 mm) at 77 degrees.

Rear: 0.203" (8 mm)

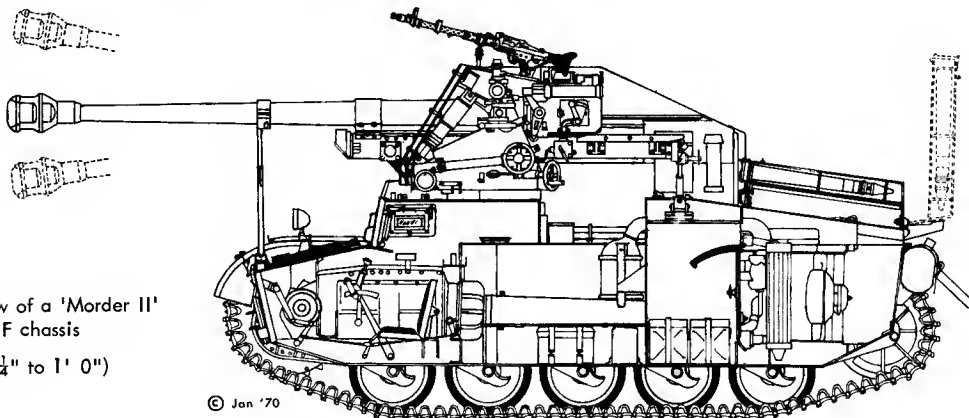
Gun shield: 2 x 0.102" (2 x 4 mm) at 30 degrees.

night fighting.

The main four view drawing is of an early production vehicle as described in the official handbook D 651/50 of 1st December 1942. A late model is depicted in the additional two side views. The main differences were in the relocation of equipment stowage based upon combat experiences, eg. the starting handle was moved to the rear plate where it was most needed. An additional crewman was provided and the radio equipment aerial moved to the lefthand side. The new pattern driving light and MG 42 were then standard. Heavy steel towing lugs were welded to the front nose plate and to compensate for the additional weight and recoil forces of the gun, volute spring bump stops were fitted on the first, second and last wheel stations, similar to the 'Wespe'. The section view drawing should be studied alongside the section view of the Ausf.F. the chassis on which it is based. It can be readily seen how little modification was undertaken.



Interior detail of the fighting compartment of the 'Marder II' viewed from the top of the ammunition bins. This is one of the early models, in which the driver had the dual function of operating the radio. Later models had the radio on the opposite side in the position occupied by the fire extinguisher in this photograph.



Section view of a 'Marder II'
on the Ausf F chassis

1:48 scale ($\frac{1}{4}$ " to 1' 0")



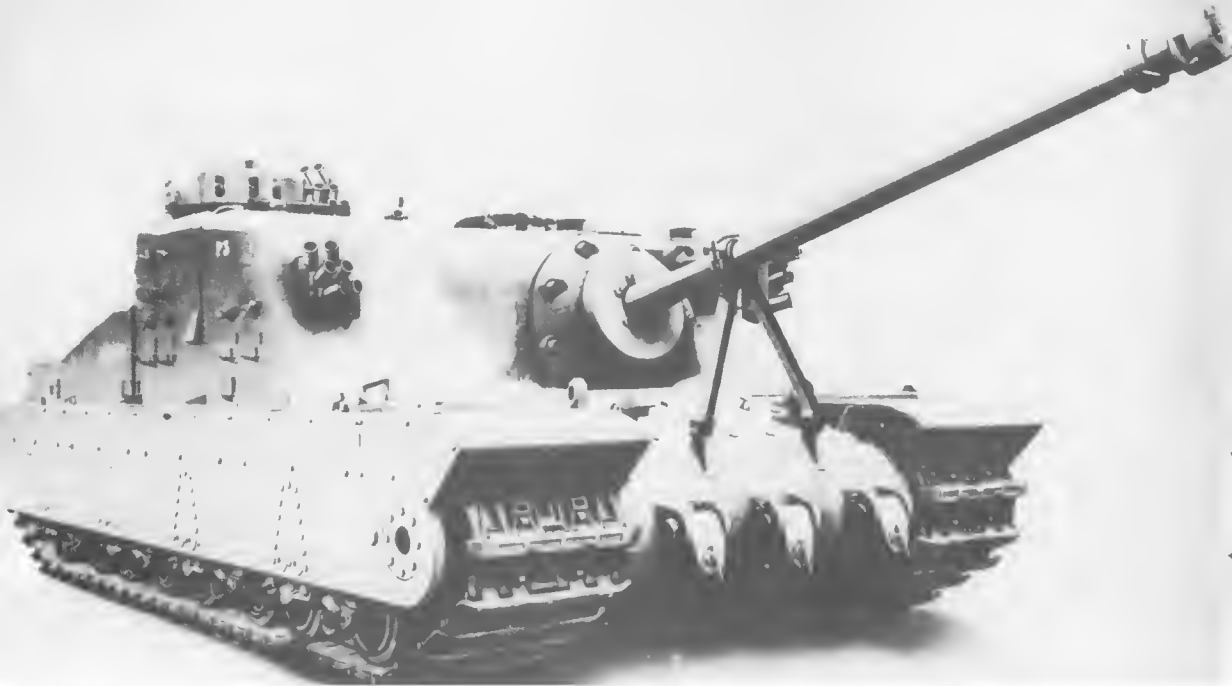
ABOVE: A 'Marder II' destroyed in action in North Africa. As in most pictures of destroyed 'Marder' vehicles, the ammunition has exploded ripping off the bins and rear of the vehicle.
(Imperial War Museum Photograph)

Grateful thanks are rendered to A. L. Sohns for his assistance in the research carried out on the 'Marder II'

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BELOW: A 'late' version of the 'Marder' being prepared for travel with canvas covers in place. Note that the track links are carried in two rows on the nose rack.





ABOVE: Front view of the 'Tartaise' - Heavy Assault Tank A39. Records are confused as to how many vehicles were ordered and how many were completed. It is known that at least two were finished, as these are now at the R.A.C. Tank Museum, Bovington. However, it is interesting to note the marking P3 on the side of this vehicle which may indicate that it was the third prototype vehicle. (Imperial War Museum Photograph)

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BELOW: Rear view of a 'Tartaise'. The armoured engine compartment is offset to the left with a section over the left track cover in which the electricity generator and associated batteries were mounted. The fixture on the right hand track cover was only a light storage box. (Imperial War Museum Photograph)



In 1942, a very heavily armoured vehicle was required that would be capable of leading the assault through an artillery barrage.

The G.S. Specification A.39 was issued and Nuffield Mechanisations commenced work on five or six pilot models. Records conflict both as to how many were ordered and how many reached completion. The first pilot vehicle moved under its own power, about 18 months after work started, with Sir Miles Thomas at the controls. At least two vehicles were completed and possibly the remainder, although the lapsing of the requirement and the consequent lack of urgency saw them only finally ready in 1947.

The hull was of single skin all-welded construction with the front and upper hull formed by two castings and the remainder of the hull with plates, the whole structure being divided into three main compartments. The front compartment housed the gearbox which was accessible through the hatches on top of the front casting. The fighting compartment in the centre of the vehicle housed the crew of seven and the rear compartment housed the engine.

The engine was a Rolls-Royce Meteor Mk.V 60 degrees V-12 OHV normally aspirated, pressure liquid cooled for gasoline operation and developing 650 BHP and 2500 rpm.

Unlike contemporary British tanks the drive from the engine was taken forward through a triple dry-plate clutch and conventional propeller shaft to the gearbox.

The gearbox was a Merritt-Brown H51D combined change speed and steering unit with six forward and six reverse speeds, incorporating two controlled differential steering units, one each side of the gearbox. From each steering unit the drive passed to the two-speed reduction final drive and a 19 tooth twin ring driving sprocket. The gear reduction was obtained through spur gears and epicyclic gear trains.

The vehicle was suspended on four similar equally spaced units along each side of the hull. Each unit carried a pair of double rubber tyred road wheels on swinging arms, one leading and one trailing, independently pivoted on a common axis. To ensure equal loading on all road wheels, independent torsion bar springing was employed arranged in groups of four, lying transversely across the hull floor. One end of each torsion bar was anchored to the hull side and the free end pivoted in the suspension bracket and connected to its double road wheel by an arm and shackle with an articulated linkage to the axle. Hydraulic double-acting twin cylinder levers operating shock absorbers were fitted at wheel stations 1, 3, 6 and 8.

Each track was composed of 62 manganese steel webbed and spudded links 36 ins. wide, hinged with dry hardened steel pins and supported on six double rubber tyred rollers. A double rubber tyred track tensioning idler wheel was fitted at the rear of each run of track.

The main armament was an OQF 32-pdr. Tank Mk.I having a calibre of 3.7 ins. (94mm) and a barrel length of 62 calibres. This gun was a development of the 3.7 ins. Anti-Aircraft gun and was mounted in a ball and socket in the front plate of the fighting compartment. A limited power assisted traverse of 20 degrees to either side of centre was provided. The gun had a vertical sliding breech block working in a closed jaw breech ring. The firing mechanism was percussion and the normal method of firing was electrical. Separate ammunition was used and was to be available in APCBC and HE types with stowage for 60 rounds. A single 7.92mm Besa machine-gun with a limited traverse of 20 degrees left and 15 degrees right was mounted in the front hull.

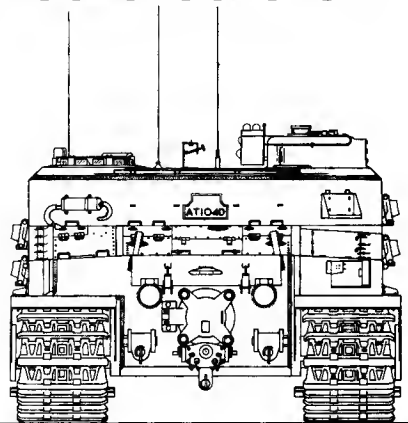
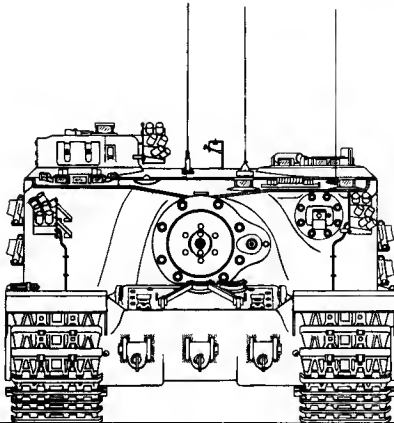
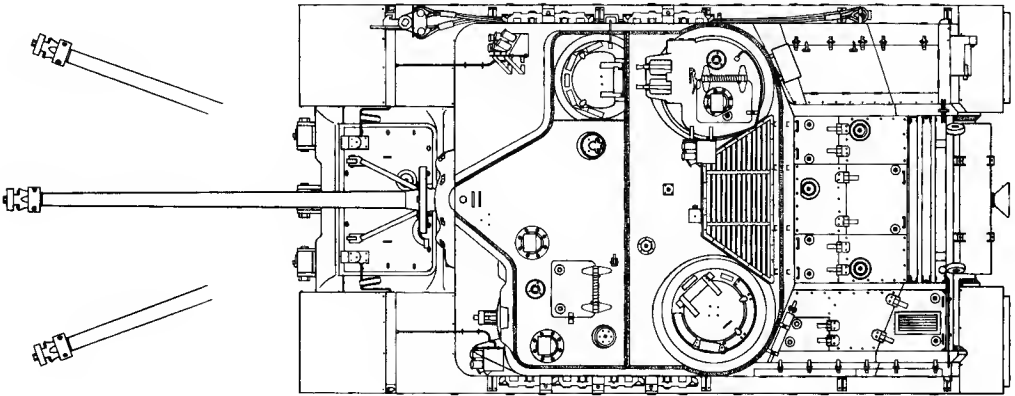
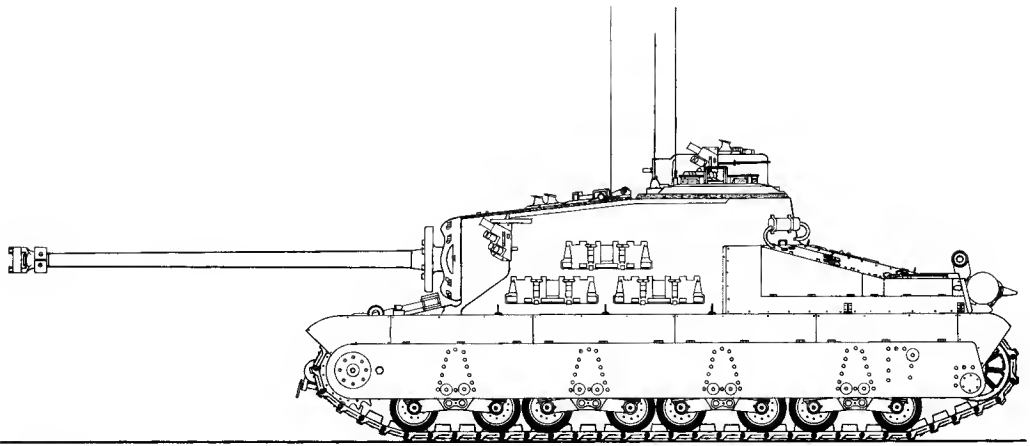
A twin 7.92mm Besa machine-gun mounting was provided in the cupola on the hull roof. This cupola had a 360 degrees hand operated traverse. Both these machine-gun mountings had an elevation of 15 degrees and depression of 10 degrees.

A 2 ins. bomb thrower and multi-barrelled smoke dischargers were also provided.

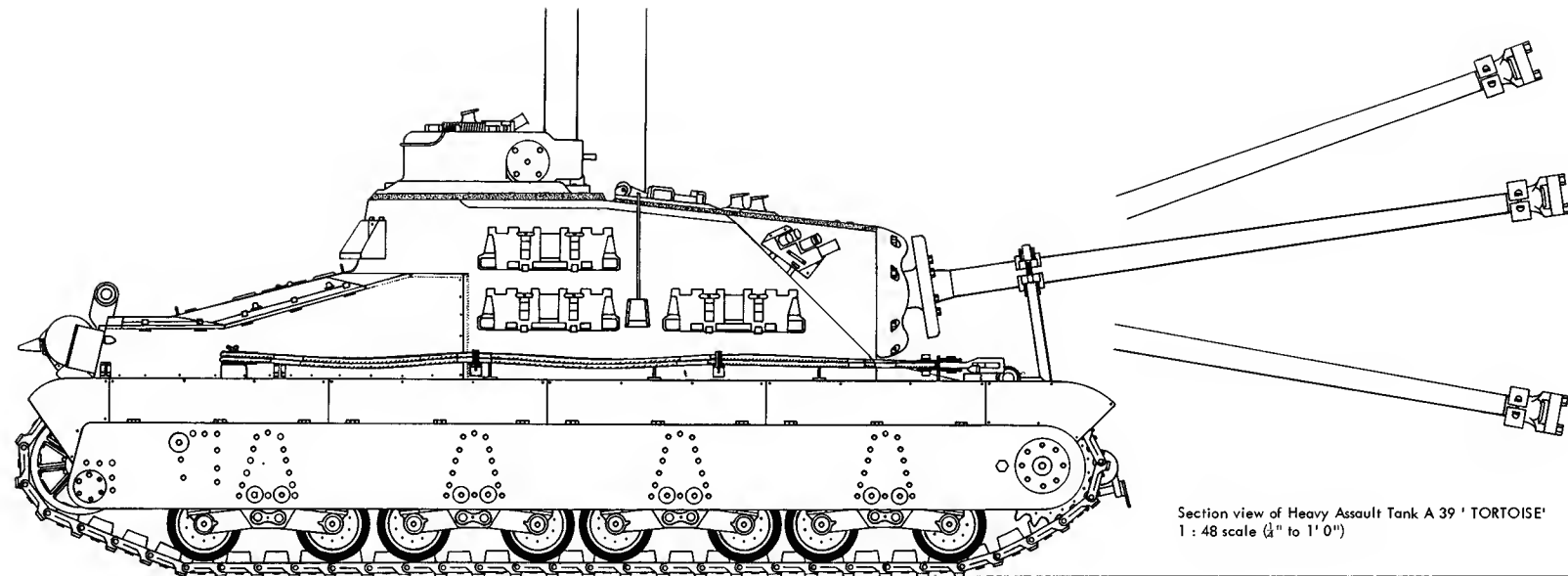
Vision equipment comprised of a Cupola having eight fixed episcopes, one extensible episcope and a periscope binocular for the Commander. The twin machine-gun cupola had one periscope and one sighting telescope.

The main gunner and the front machine-gunner were each provided with one periscope and one sighting telescope and the driver with five fixed episcopes.

Two examples of the TORTOISE are now on display at the R.A.C. Tank Museum, Bovington, Dorset. The same basic concept inspired the design of this vehicle and the American Super heavy tank T28 and it is recommended that the T28 (Bellona Print Series 8, No.31 & 32. US) be studied in conjunction with the 'TORTOISE'



HEAVY ASSAULT TANK A39 'TORTOISE'



Section view of Heavy Assault Tank A 39 'TORTOISE'
1 : 48 scale ($\frac{1}{4}$ " to 1' 0")

Technical Specification for Heavy Assault Tank A 39 'Tortoise'

Crew: 7 (Commander, Driver, Three Gunners, Two Loaders)
Weight: Combat loaded: 179,200 lbs. 90 short tons,
80 Long tons, 78.7 tonnes.

Performance

Speed, Max. Road: 12 m.p.h. (19.5 Km.p.h.)

Max. Gradient: 30 degrees
Fording depth: 4' 6" (138 cm) Deep wading: 16' 0" (486cm)
Trench crossing: 8' 0" (243 cm)
Step: 3' 0" (91.44 cm)
Min. Turning circle: 8' 0" (243 cm)
Ground pressure: 12½ lbs/sq.ins (0.86 Kg/sq.cm)
Range (Internal fuel), Road: 28 miles (45 Km)
Cross Country: 14 miles. (22.5 Km)

Dimensions

Length overall: 33' 0" (1083 cm)
Length: 23' 9" (725 cm)
Width overall: 12' 10" (421 cm)
Height: 9' 0" to top of cupola periscope (325 cm)
Ground clearance: 1' 3" (38 cm)

Fire height of gun: 6' 0" (183 cm)
Road wheel dia (overall) 1' 8" (50.8 cm)

Trackwork

Centres: 9' 3½" (286 cm)
Length on ground: 15' 9" (516 cm)
Width: 3' 0" (91.44cm)
Pitch: 9½" (24 cm)

Number of links per track: 62
Type: Single Pin, Manganese.

Mechanical Details.

Engine: Meteor Mk V 12 cylinder Vee Petrol 650 bhp at 2,500 RPM.

Transmission: Merrit Brown, 5 speed close ratio with emergency low.
All speeds reverse.

Steering: Controlled differential.

Suspension: Torsion Bar.

Armament

Main: Ord. QF 32 pdr. Tk Mk1.
Calibre, and length in calibres: 94 mm (3.7ins). L/62.
Traverse: 20 degrees L, 20 degrees R, Operation: Power assisted.
Elevation: plus 18 degrees, minus 10 degrees hand operated.

Secondary armament:

2 x 7.92 mm Besa M.G.s. hand traverse 360 degrees traverse
roof cupola 15 degrees elevation, 10 degrees depression.
1 x 7.92 mm Besa M.G. hull ball-mount.
1 x 2" Bomb thrower & 3 Multi barrelled snake discharger.

Stowage

Ammunition, main armament: 60 rds.
Ammunition, secondary armament: 7,500 rds.
30 x rounds of smoke 2" Bomb thrower.
18 rounds smoke in multi barrelled smoke discharger.

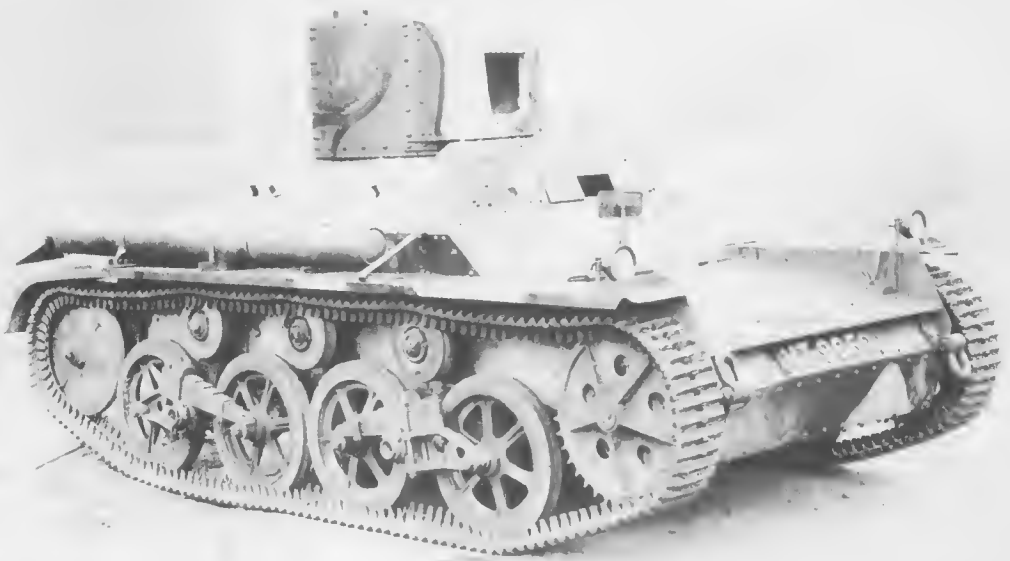
Internal Fuel capacity: 140 Imp. gals.

Armour

Cast differential housing
Cast fighting department
Plate elsewhere

Thickness: Front: 9" (229 mm)
Sides: 6" (152 mm)
Rear: 3" (76 mm)
Sides of engine compartment 4½" (114 mm)
Side skirts: 2" (50 mm)

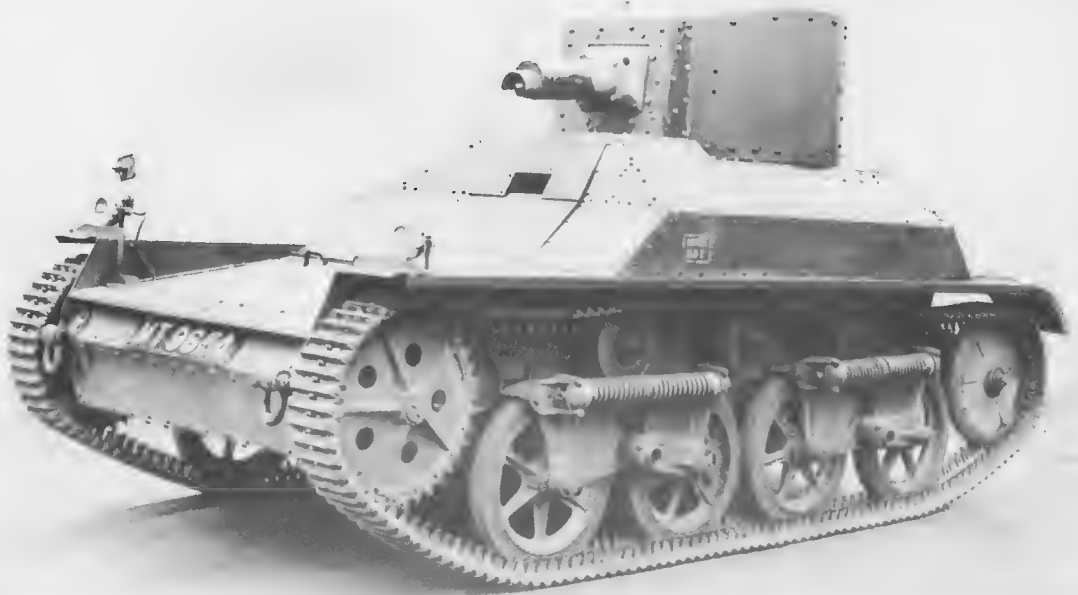
W/T Equipment No. 19 & No.38 wireless sets.



ABOVE: The Light Tank Mark IA - A 4 E6 is shown here with the machine gun removed. Note the exhaust silencer arrangement which indicates that this vehicle was powered by a Ricarda diesel engine. The Ricarda engine was fitted in 1934 to replace the original Meadows unit. The camouflage pattern of green, sand, and grey is separated by black outlines.

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BELOW: The A4 E8 differed from the A 4 E6 and E7 by having been built with Harstmann coil spring suspension. This vehicle was sent to Egypt in 1934.



Development of the Carden Loyd Light Tanks progressed steadily during the 'thirties', the Mk 1A series of five experimental light tanks being the logical development of the earlier Mark 1 series (bellona Prints, series 16, Na.61 UK) to which they were similar in appearance. The most notable improvement being the more effectively sloped glacis and drivers plates.

Layout followed the Mk 1 practice the hull being of single skin armour plates bolted to mild steel angles.

The Driver was seated at the left front of the vehicle and the Commander/Gunner occupied the Fighting Compartment in the centre of the vehicle, behind the Driver. A Meadows engine was mounted longitudinally in the right front of the vehicle, alongside the Drivers and Fighting Compartments. The radiator was mounted at the rear of the vehicle and expelled the cooling air through louvres on the hull rear plate. Drive from the engine was transmitted forward through a conventional single plate dry clutch and Meadows 4F and 1R speed sliding pinion gearbox to a differential gear, from which the drive was taken either side to a 40 tooth single ring drive sprocket via the steering clutch and broke. The vehicle was suspended on four 20 in. dia. six-spoke rubber tyred road wheels each side. Each track was adjusted by an eccentrically pivoted ratchet arc tensioning device incorporated in the rear idler wheels. Each top run of track was supported by three rubber tyred rollers.

The A4.E6 vehicle was delivered to the MWEE for trials in Sept. 1930.

The Meadows engine was replaced by a Ricardo S65/4 Diesel engine between Feb. and Aug. 1934, the vehicle being finally broken up in April 1935.

A disruptive camouflage, similar to that used on A4.E2 was used on this vehicle.

A4.E7 was delivered for trials in Oct. 1930 and was fitted with the single coil spring Harstmann suspension in March of the following year. In Feb. 1932 this vehicle also had the Meadows engine replaced with a Ricardo S65/4 Diesel engine. The vehicle was broken up in 1934.

The Ricardo S65/4 was a four cylinder in-line water cooled, single sleeve valve four stroke engine for Diesel fuel operation

A bore and stroke of $4\frac{3}{8}$ in. x $5\frac{1}{2}$ in. (121mm x 140mm) gave a swept volume of 391 cu.in. (6412cc). Power output was approx. 70 BHP @ 1900 rpm.

The engine was directly mounted to a conventional single plate dry clutch and Dorman 3F and 1R speed gearbox.

The third vehicle A4.E8 was developed in Oct. 1930 and was built with the Harstmann suspension incorporated. The vehicle was delivered to Egypt in Jan. 1934, but its ultimate fate is unknown.

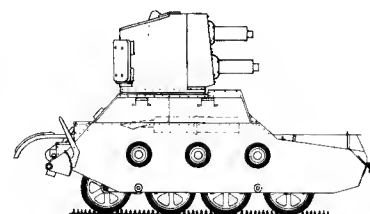
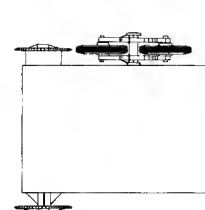
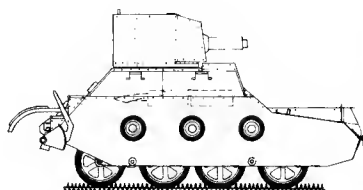
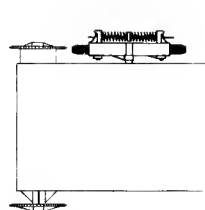
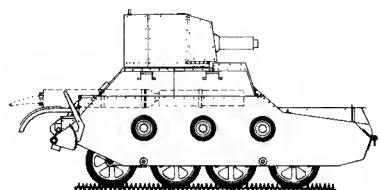
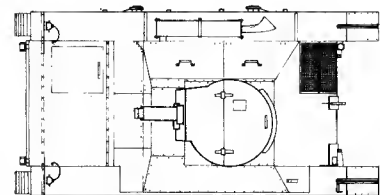
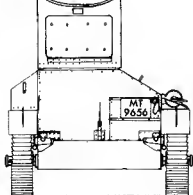
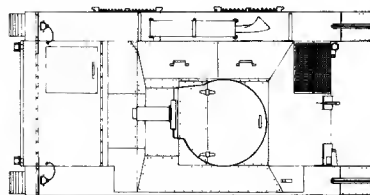
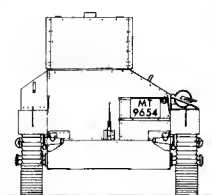
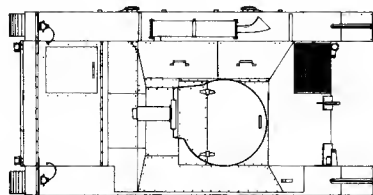
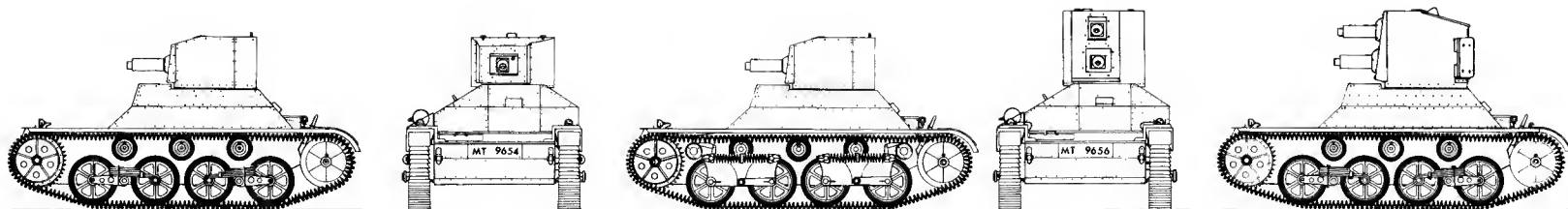
Records for the A4.E9 are sparse. It was delivered for trials in Oct. 1930 and sent to Egypt in Feb. 1934 although again its ultimate fate is unknown. It was presumably similar to E8, although no photographic evidence has yet been found to support this theory.

A4.E10 is probably the most interesting, visually, of the quintet. It was delivered for trials in Nov. 1930 and featured a large turret with tandem Vickers machine-guns, a .5in. and a .303 in. above it. In all other aspects the vehicle was the same. New suspension was fitted in Feb. 1932, but the records do not show what type this was. In Jan. 1935 the vehicle was sent to Field Stores for demolition tests.

All five vehicles were built by Vickers and were designated as follows:

A4.E6	MWEE 244	T 855	MT 9652
A4.E7	MWEE 245	T 856	MT 9653
A4.E8	MWEE 251	T 857	MT 9654
A4.E9	MWEE 252	T 858	MT 9655
A4.E10	MWEE 256	T 859	MT 9656

In the drawing, the sectioned side view shows the additional exhaust silencer used with the Ricardo diesel engine installations.



A4.E6,E7

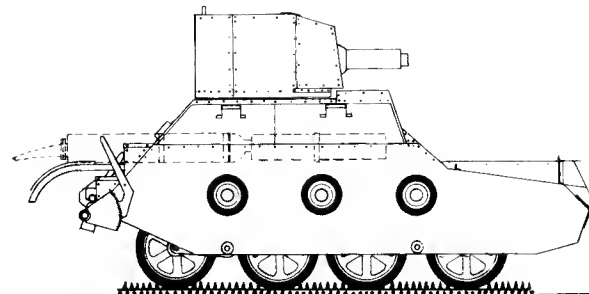
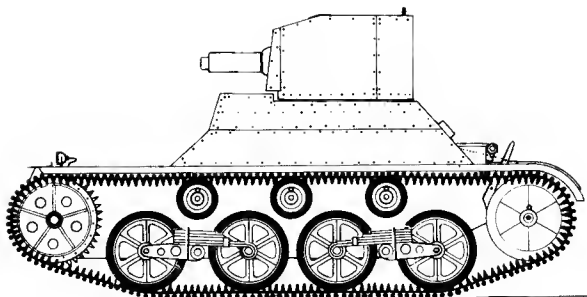
A4.E8,E9

A4.E10

LIGHT TANK Mark 1A



SCALE 1" = 76 (4mm. to 1 foot) Drawn by A. GOOCH



Side views of the Light Tank Mk IA E6 reproduced at 1 : 48 scale ($\frac{1}{4}$ " to 1' 0"). The silencer shown on the right hand view is that used with the Ricardo Diesel engine installation.

Technical Specification for Light Tank Mk. IA (A4, E6, E7, E8, E9 and E10)

Crew: 2

Weight, Combat loaded: 10080 lbs.
4.5 Long tons, 5.04 Short tons.
4.43 Tonnes.

Performance

Speed, Max. Road: 30 m.p.h. (48 Km.p.h.)
Max. Gradient: 45 degrees.
Fording depth: 2' 6" (76.2 cm)
Trench crossing: 5' 0" (152.4 cm)
Step: 2' 1" (63.5 cm)
Ground Pressures: 6.14 lbs/sq. ins. (0.432 Kg/sq. cm)
Range (internal fuel) Road: 160 miles (256 Km)
Power to weight ratio: (Net). 13.3 HP/ton.

Dimensions

Length overall: 12' 0" (365.76 cm)
Width overall: 6' 0" (182.88 cm)
Height: 5' 11" (180.34 cm)
Ground clearance: 10 $\frac{1}{2}$ " (26.67 cm)
Fire height of gun: 4' 10" (147.32)
Road wheel dia (overall) 1' 8" (50.8 cm)
Road wheel width: 2 $\frac{1}{2}$ " (6.35 cm)

Trackwork

Centres: 5' 2" (157 cm)
Length on ground: 6' 0" (182.8 cm)
Width: 19 $\frac{1}{2}$ " (24 cm)
Pitch: 1.758" (4.47 cm)
Number of links per track: 169.
Type: Forged or cast steel, Dry pin.

Mechanical Details.

Engine: Meadows 6 EPC 6-cylinder in line OHV water cooled, normally aspirated gasoline, spark ignition.
Bore x Stroke 3' x 3 $\frac{3}{8}$ " (76 x 120 mm) = 201 cu. in. (3300cc) compression
Ratio 5:1 60 BHP @ 3000 RPM.

Transmission: Single plate dry clutch and Meadows 4F and 1R speed crash gearbox. 40 tooth single ring sprocket 22.38" P.C.D.

Steering Clutch and brake.

Suspension: 'Slow Motion' with quarter elliptic leaf springs. or 'Horstmann' with single coil springs and friction type shock absorbers on front and rear stations only.

Armament

Main: 1 - .303" (RC) Vickers machine gun in block mounting.
1 - .303" and 1 - .5 Vickers machine guns in duplex mounting (A4 E10 only)

Troverse: 360 degrees. Operation: Hand, turret.

Stowage

Ammunition, main armament: .303 - 4000 rds.

Armour

0.5" (12 mm) Min - 0.7" (18 mm) Max.

Type: Rolled steel plates.

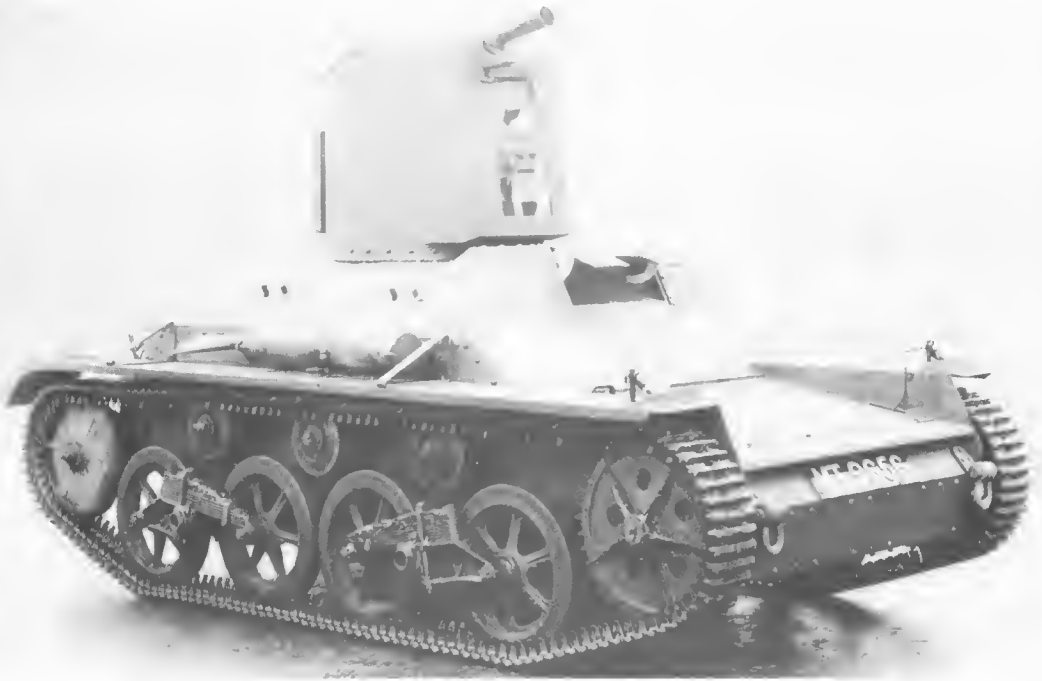
Hull, Nose upper: 0.7" (18 mm) at 45 degrees.
Nose lower: 0.7" (18 mm) at 70 degrees.
Glacis plate: 0.5" (12 mm) at 8 degrees.
Drivers plate: 0.7" (18 mm) at 42 & 71 degrees.

Sides, at 30 & 33 degrees.

Rear, upper: at 48 degrees.
lower: at 25 degrees.

Belly, at 0 degrees.

NOTE: British standard angles 0 degrees = Vertical



ABOVE: The Light Tank Mark IA - A4 E10. As can be seen, this interesting vehicle was developed to carry a turret mounting two machine-guns one over the other. One being a .5 ins. and the other a regular .303. This vehicle did not incorporate Horstmann suspension.

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BELOW: Rear view of the same vehicle after the machine guns had been fitted in the turret. Note the heavy counterweight on the back of the turret to compensate for the weight of the two machine guns.



Drawing and Historical research by D.P.Dyer.

The Cavalry of the U.S. Army had been assigned the development of mechanised forces in 1931, and were well aware of the necessity of field artillery to accompany their Combat Cars. Starting virtually from scratch it took until 1939 before the 7th Cavalry Brigade Mechanised, even had a full complement of Combat Cars, so it is little wonder that action to develop a gun carriage with the same degree of mobility as the Combat Cars was so late starting. The requirement was officially made by a board of officers on 27th July 1938 at the H.Q. of the 7th Cavalry Brigade Mechanised, Fort Knox, Kentucky. Characteristics were drawn up, development approved by the chief of Field Artillery, and a study made by the Ordnance Department early in 1939.

For the purpose Combat Car M.1 No.54 was furnished by the 1st Cavalry Regiment for modification. The Combat Car turret was removed, the height of the fighting compartment increased, and a .30 cal m.g. turret (as fitted on Light Tanks M2A3) located on the left of this new roof behind the driver. A large folding hatch taking up the right hand side. A 75mm Howitzer M1 A1 was mounted to the right of the transmission tunnel in the position normally occupied by the bow gunner, the frontal armour in this position being cut away and replaced by two doors through which the howitzer protruded. The shape of the front of the right hand sponson was altered, and a door that opened outwards and downwards fitted into the side. A recoil guard was fitted to the howitzer, and ammunition racks positioned below this to provide stowage for 25 rounds. A further ammunition rack containing 36 rounds was located in the left hand sponson.

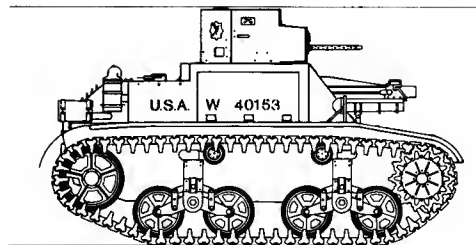
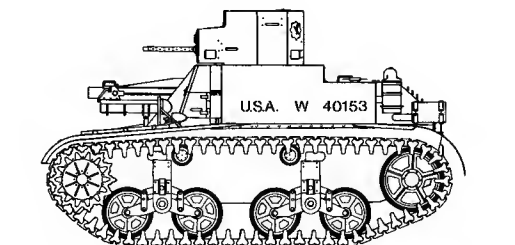
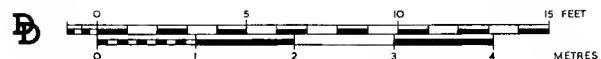
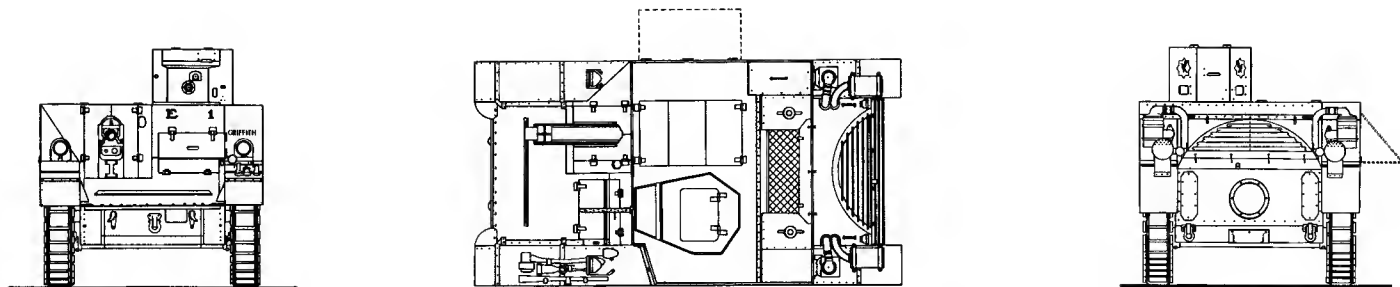
Tests were conducted on this vehicle by the Ordnance Department of Aberdeen Proving Ground, and the Field Artillery Board at Fort Bragg, North Carolina. It was issued to 'E' Troop, 1st Cavalry Regiment Mechanised at Fort Knox on April 15th 1940, for user trials and it participated in the Third Army manoeuvres in Louisiana during May 1940 by which time it had covered well over 1,500 miles. These exercises proved beyond a shadow of a doubt the importance of a self propelled gun for close support, while at the same time highlighting the faults of this design.

Lock of space allowed room for a crew of only two. The driver drove the vehicle and placed it approximately in position facing the target upon touch signals from the gunner/commander tripping the firing lever when instructed. The commander/gunner was also responsible for selecting the target, placing the vehicle in position, estimating range, servicing the piece, setting the sights, handling the gun and observing fire. The howitzer being mounted to the right of the gunner was awkward to service, and the panoramic sight position made this difficult to use.

Crew protection was below that of the combat car for various reasons. The gun travelling lock was located outside the vehicle requiring a crew member to expose himself when securing or releasing the howitzer for travel. The front armoured doors had to be open to allow traverse or elevation of the howitzer. In order to disperse fumes, all hatches had to be open whilst firing. Even when closed the fact that there were hatches materially weakened the effectiveness of the armour protection on these faces, allied to there being no bullet splash protection for the sight aperture or the front doors.

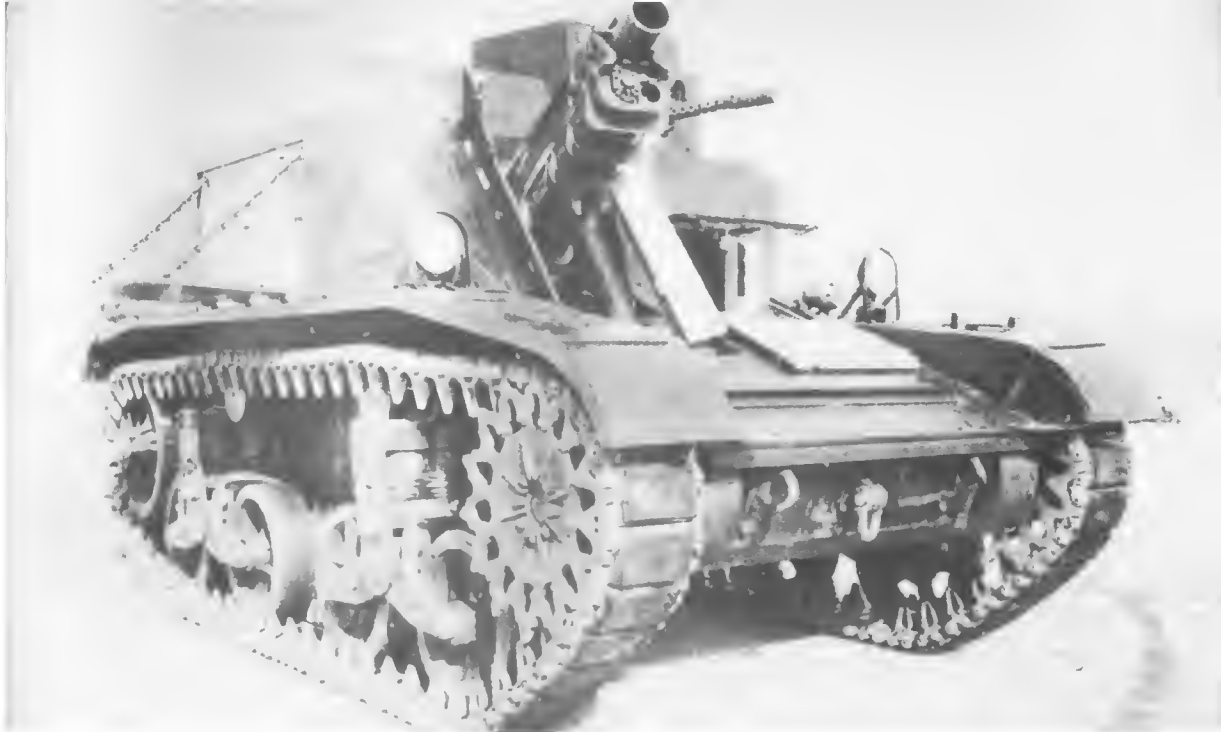
It was considered that the 10 degree depression of the howitzer was tactically insufficient for firing from reverse slopes, and the restricted traverse was insufficient to allow attack on a target moving across the front of the vehicle at close range, or to shift fire from one target to another. The turret top being approximately three feet above the drivers observation slit meant that in order for the driver to observe fire, a good target would be presented to the enemy. Owing to the lack of space, the mounting of the weapon and sights, and the numerous duties of the crew, the rate of fire was slow. Three shots a minute was the best that could be achieved, as compared to eight rounds in the first half minute from the same gun on a towed carriage once it had been emplaced.

With the formation of the Armored Force it was considered on the 27th August 1940 that the 75mm H.M.C. was unsuitable for use, and it was recommended that a vehicle of the Medium Tank Class would be more satisfactory for the mounting of a 75mm calibre weapon, allowing a larger gun crew and greater ammunition stowage. This was to be given urgent priority. It would appear from this that the Armored Force Board were not aware of the conversion of the Medium Tank T.5. Phase III carried out by the Ordnance Department to produce the Medium Tank T.5.E.2. between May and September 1939 which happened concurrently with the conversion to produce the 75mm H.M.C.T.3. No doubt a certain amount of confusion arose from the fact that the howitzer mounted on a Combat Car chassis was termed a Howitzer Motor Carriage, whereas an exactly similar conversion of a Medium Tank was termed a Medium Tank and as such in 1939 could only be allocated to the Infantry.



75_{MM} HOWITZER MOTOR CARRIAGE T3

SCALE 1:76 (4mm to 1foot) Drawn by D.P.DYER

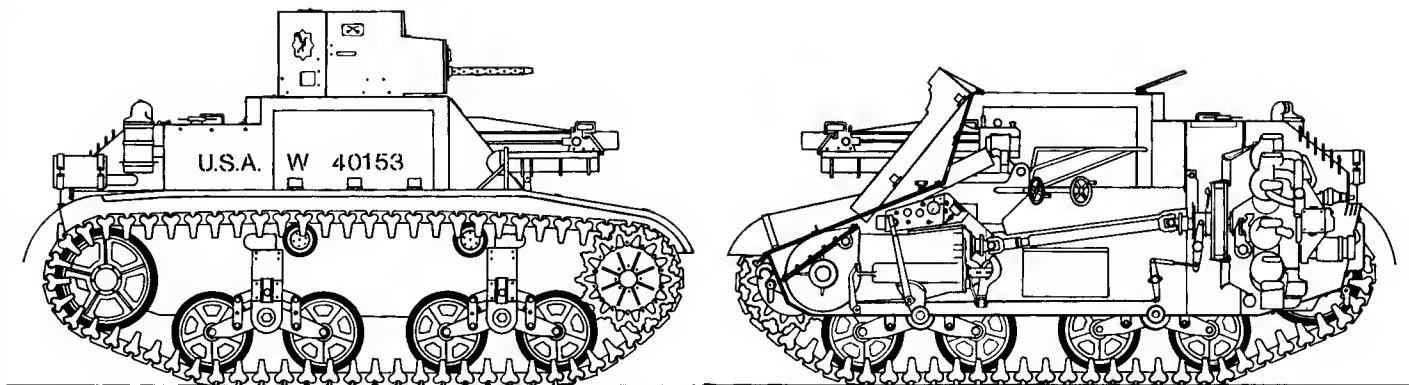


ABOVE: Many interesting and important lessons were learnt during the Field trials of the 75mm Howitzer Motor Carriage T.3. One of the major disadvantages of the design is highlighted in this photograph - the fact that the hatches had to be left open during the firing of the howitzer. The howitzer is at 20 degrees of elevation and at 15 degrees of right traverse. (U.S. Official Photograph)

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BELOW: This photograph shows the 75mm Howitzer Motor Carriage T.3 during tests at the Aberdeen Proving Ground, Maryland, during early January 1940. The test in progress was to discover the ability of the vehicle to negotiate wire barriers. The wire snarl shown did not stop the T.3. (U.S. Official Photograph)





ABOVE: Section view drawing of the 75mm Howitzer Motor Carriage T.3 is reproduced here at 1 : 48 scale ($\frac{1}{4}$ " to 1' 0"). This view is of the right hand side of the vehicle and shows the details of the Howitzer mounting. Note that while radiol engines were compact the drive shaft to the gearbox intruded on the space of the fighting compartment to a great extent.

Technical Specification for 75mm Howitzer Motor Carriage T.3.

Crew: 2
Weight, Combat loaded: 20,000 lbs. 8.93 Long tons,
10 Short tons, 9.07 tonnes.

Performance

Speed, Max. Road: 45 m.p.h. (72 Km.p.h.)
Cross country: 15/20 m.p.h. 24/32 Km.p.h.
Max. Gradient: 31 degrees. (60%)
Fording depth: 2' 0" (61 cm)
Trench crossing: 5' 0" (152 cm)
Step: 2' 2" (66 cm)
Min. Turning circle: 21' 0" (64 metres)
Ground pressure: 10 lbs/sq. ins. (.7 Kg/sq. cm)
Range (Internal fuel), Road: 100 miles (161 Km)
Cross country:
Power to weight ratio: Gross 28 HP/ton.

Dimensions

Length overall: 13' 7" (414 cm)
Width overall: 7' 10" (239 cm)
Height: 8' 0" (244 cm)
Ground clearance: 1' 3" (38 cm)
Fire height of gun: 5' 2" (157 cm)
Turret ring dia: 2' 6" (76 cm)
Road wheel dia (overall) 1' 8" (50.7 cm)

Trackwork

Centres: 6' 0" (183 cm)
Length on ground: 7' 3" (221 cm)
Width: 11 5/8" (29.5 cm)
Pitch: 5 1/2" (13.9 cm)
Number of links per track: 61/62
Type: Rubber block, double pin, side guides.

Mechanical Details

Engine: Continental W 670 Series 9 250 hp. 7-cylinder air cooled
radial petrol.
Transmission: Sliding Gear
Steering: Controlled differential 4F 1R
Suspension: Vertical volute spring.

Armament

Main: 75mm Howitzer M1A1
Calibre, and length in calibres: 75mm (2.95 ins), L/18
Traverse: 15 degrees right and 10 degrees left. Operation: Manual
Elevation: plus 20 degrees, minus 10 degrees.
Max range 5,000 yds. Shrapnel
Max range 7,000 yds HE shell.

Secondary armament:

.30" cal MG ball mount in turret with 360 degrees traverse.
Manually operated.

Stowage

Ammunition, main armament: 61 rds.
Ammunition, secondary armament: 3,600 rds.
Internal Fuel capacity : 92 octane fuel.
42 Imp. gals. 50 U.S. gals. 191 Litres.

Armour

Type: Rolled plate rivetted construction.

Hull, Nose upper: 5/8" (15.9 mm) at 21 1/2 degrees.
Nose, lower: 5/8" (15.9 mm) at 62 degrees
Glasis plate: 1/2" (12.2 mm) at 68 1/2 degrees
Drivers plate: 5/8" (15.9 mm) at 18 degrees.
Sides, upper: 1/2" (12.2 mm) at 0 degrees,
lower: 1/2" (12.2 mm) at 0 degrees.
Rear, upper: 1/2" (6.1 mm) at 0 degrees.
Decking: 1/2" (6.1 mm) at 180 degrees.
Engine covers: 1/2" (6.1 mm) at 0 to 90 degrees.
Belly, Front: 1/2" (6.1 mm) at 180 degrees.
Rear: 1/2" (6.1 mm) at 180 degrees.

Turret

Front: 5/8" (15.9 mm) at 0 degrees.
Sides: 5/8" (15.9 mm) at 0 degrees.
Rear: 5/8" (15.9 mm) at 0 degrees.
Roof: 1/4" (6.1 mm) at 90 degrees.